WHITE PAPER

USDA Forest Service Pacific Northwest Region Umatilla National Forest

WHITE PAPER F14-SO-WP-SILV-24

How to Measure a Big Tree[1]

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HISTORICAL CONTEXT

The Umatilla National Forest (NF) has a long-standing program to locate, measure, and recognize the largest individual trees of each species (the Big Tree Program). The nominator(s) of a big tree is recognized with a certificate and a non-monetary award, and a yellow placard is attached to the tree so others will know it is registered in the Umatilla NF's big-tree program.

The Umatilla NF big-tree program was designed to address biological diversity concerns by locating and reserving the largest examples of each tree species occurring on the Forest (reserving them from timber harvest, but this is a recommendation, not a legal or policy requirement). It was also designed to be compatible with national and state programs.

The Umatilla National Forest initiated a big-tree program when Forest Supervisor Jim Lawrence approved a pilot project proposal in January of 1988. The program's first nominations did not occur until the 1989 field season, when 13 big-tree forms were submitted.

The Umatilla NF big-tree program includes 45 species – the national list was consulted, and every species in the national program occurring on the Forest was included in our list of qualifying trees, even those species that tend to grow as shrubs rather than trees in this area. [The big-tree program is described in white paper F14-SO-WP-SILV-1, *Big tree program*.]

Since big-tree programs have specific requirements about how to measure trees, and since some of these requirements differ from conventional forestry practice, this guide was developed to help those who would like to measure and submit a big-tree for consideration.

[1] White papers are internal reports; they receive only limited review. Viewpoints expressed in this paper are those of the author – they may not represent positions of the USDA Forest Service.

INTRODUCTION

To measure a Big Tree, you'll need a few basic tools. In cases where the tree is very large, it would also be nice to have an assistant help with the measurements. If you don't have the proper equipment or knowledge to get the job done, please contact the Forest's Big Tree Coordinator and he will be happy to assist you.

Before you get started, obtain a blank copy of the Champion Tree Nomination Form. Every tree should be submitted on its own nomination form. You can download a form from the Umatilla National Forest's big-tree website: www.fs.fed.us/r6/uma/nr/silv/bigtree.shtml

First you must identify the tree species because it is the first item that needs to be recorded on the nomination form. However, some of the minor tree species may be difficult to identify correctly, in which case you should verify your identification using a botanical reference such as "Flora of the Pacific Northwest" or a regional tree guide such as "Trees to know in Oregon." A list of tree identification books is included at the end of this document.

If you are uncertain of your identification (is it an alder or a birch?), collect a sample for verification. If you do collect a sample, be sure to include both foliage and fruits if possible.

Each tree you nominate will be scored using a point system. The points are assigned based on three of the tree's dimensions – its circumference (in inches), its height (in feet), and one-quarter of its crown spread (in feet). A process has been established for measuring these dimensions, and it is described in the remainder of this document.

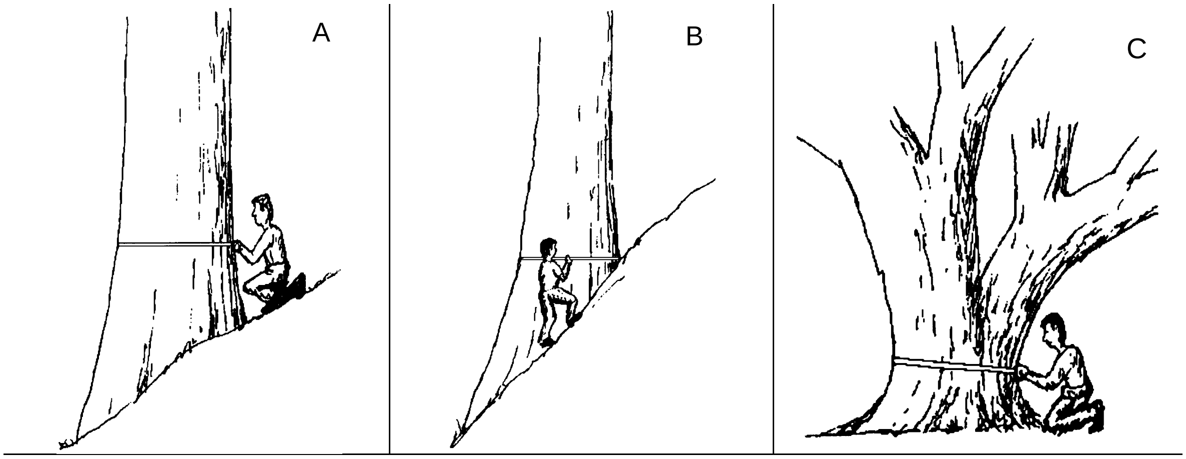
TREE DIAMETER OR CIRCUMFERENCE

Diameter should be measured with a diameter tape made of steel, not something that might stretch. Although you can wrap a piece of twine around the tree to measure its circumference, this yields only an estimate and it will be necessary to remeasure the diameter with a steel tape.

Diameter is measured at breast height, defined as 4½ feet above <u>average</u> ground level. ***This measurement standard differs from conventional forestry practice, where diameter is measured at 4½ feet above ground level on the uphill side of the tree.***

Diameter measurement problems are often related to the phrase "above average ground level." When trees are growing on a slope or uneven ground, the rule is to measure 4½ feet from both the uphill and downhill sides, find a point halfway between the two (this is the mid-point or average level), and then measure diameter there.

If a slope is so steep that the mid-point ends up <u>below</u> ground level on the uphill side of the tree, then it may be necessary to measure diameter at a point above 4½ feet. In this situation, measure the tree as near to ground level as possible and record the measurement height on the nomination form. See figure below for an example of this diameter measurement scenario.



Diameter Measurement Examples. Example A shows diameter being measured at 4½ feet above average ground level. This can be done in two ways: on an even slope, find the point that is midway between the uphill and downhill sides, measure 4½ feet up from there, and then measure diameter. Or, measure 4½ feet from both the uphill and downhill sides of the tree, find the mid-point between the two, and measure diameter there (if the uphill and downhill points are 12” apart, then the proper place to measure diameter is either 6” below the uphill point or 6” above the downhill point). Example B shows diameter being measured at the soil surface because the tree is growing on a very steep slope. In this situation, it is not uncommon for average ground level to be at the soil surface for the tree’s downhill side, or perhaps even below the soil surface. If a soil surface measurement turns out to be higher than 4½ feet above average ground level, note the actual height on the nomination form. Example C shows how to measure diameter for a forked tree. For multi-stemmed trees (those with more than two branches), the largest stem should be selected and measured at 4½ feet. For forked trees (those with two main branches), measure directly below the fork (as shown in the diagram) and note the measurement height on the nomination form.

Measuring diameter can be tricky because trees often grow in unusual situations or come in unusual shapes. Trees that are leaning, growing in hummocky terrain, or have an unusual shape (pistol butts, forks, butt swells or buttresses, etc.) offer a measurement challenge:

1. If there is a growth or branch at breast height, measure diameter at the narrowest point below 4½ feet and note the actual measurement height on the nomination form.
2. For multi-stemmed trees, measure the single largest stem at a point 4½ feet above average ground level. Be careful to evaluate multi-stemmed clumps carefully because it can be difficult to tell if the clump is derived from one or many trees. In some situations, each stem in a clump is obviously part of the same tree; in others, such as whitebark pine, several trees may have grown together (fused at the base) to form a clump.
3. If several individual trees grew together to form a clump, then each individual stem should be evaluated as a separate tree and measured as close to 4½ feet above average ground level as possible.
4. If each stem is obviously derived from a single tree, then judgment is needed: if many stems indicate that the tree is branched below 4½ feet, then measure the single largest branch (stem) at 4½ feet; if only two stems are present, then the tree is forked and you should measure the smallest trunk diameter below the fork, and note the actual measurement

height on the nomination form (example C above shows how to measure a forked tree).

Note: When calculating your tree's score for the Forest's "Register of Big Trees," a diameter measurement will be converted to circumference. The national scoring system for big trees has always utilized circumference rather than diameter.

TREE HEIGHT

Height is measured from ground level, on the uphill side of a tree, to the tip of a tree's tallest leader. A height measurement is best obtained by using forestry instruments such as a clinometer or relaskop. Although it's possible to estimate height using a stick or ruler and a process that won't be described here, this method yields an approximation only. It would then be necessary to revisit the tree and obtain an accurate measurement by using an instrument.

When measuring height for a very tall tree, it's important to get far enough way to stay within the accurate range of the scales in a clinometer or relaskop. Usually, this means a long tape is needed; a 100-foot logger's tape is a minimum, and a 200-foot tape is often required for trees over 150 feet tall.

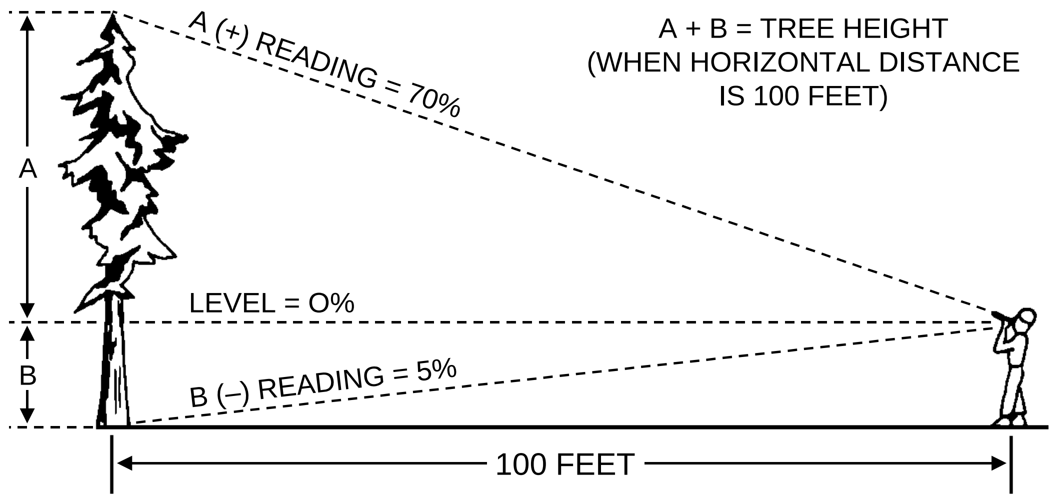
Measuring tree height on level ground is relatively easy. When working on steep slopes, it can be trickier and the instrument readings may need to be adjusted to convert from slope distance to horizontal distance.

The examples described next show how to measure tree height in three different situations; all assume use of a common instrument called a clinometer (short for an incline meter).

1. **Measuring height on flat ground and assuming a 100-foot baseline distance.**

   This is the simplest height measurement scenario. With a percent clinometer, which utilizes a 100-foot baseline distance instead of a 66-foot baseline (which is used with a topog clinometer), you can read the top and bottom measurements directly, add them together, and end up with total tree height.

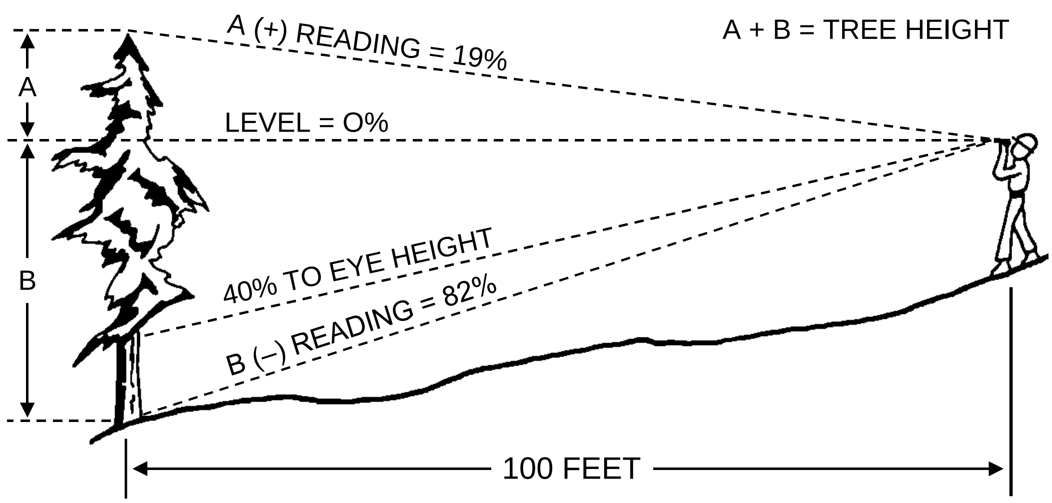
   The A (+) readings on a clinometer mean that you are looking up; the B (–) readings mean you are looking down. A level (not up or down) reading would be 0 on a clinometer. In our example below, the A (70) reading was looking up at the top of the tree; the B (5) reading was looking down at its base (where the trunk meets the ground). To get the tree's total height, you add the top reading (70) and the bottom reading (5) together: 75 feet tall for our example tree.



Measuring tree height on flat ground by using a percent clinometer and a 100-foot baseline distance.

2. Measuring height on sloping ground and assuming a 100-foot baseline distance.

Measuring tree height is a little more complicated for this scenario. When using a clinometer on sloping ground, you must apply a slope correction factor to convert slope distance to horizontal (flat) distance. Here's a height measurement example for sloping ground:



Measuring tree height on sloping ground by using a percent clinometer and a 100-foot baseline distance.

Here is the process you'd use to measure this tree's height:

a. Use the clinometer to measure the slope percent from you to your 'eye height' on the tree trunk (this sighting is a line that's parallel to the ground surface). In our example, the slope percent is 40.
b. Find a slope correction factor in table 1 for the slope percent you just measured (1.08 is

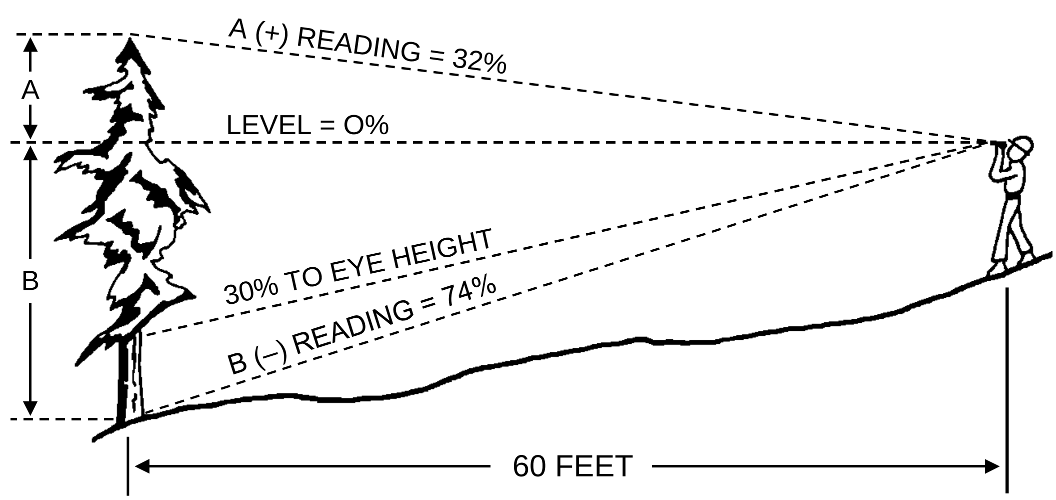
the slope correction factor for 40 percent).

c. [Note: many clinometers show slope correction factors on the same scale as the slope percent values, which is handy because then you don’t have to look them up in a table.]
d. Multiply the slope correction factor by the baseline distance. In our example with a 100-foot baseline, the result is: 100 feet × 1.08 = 108 feet. This means that on a 40 percent slope, you must be 108 feet away from a tree to get the same answer as if you were 100 feet away on flat ground.
e. Back up to 108 feet from the tree before taking clinometer readings of its top and base.
f. Take clinometer readings of the tree’s top and base, and add them together to come up with a total height. In our example, the result would be: 19 + 82 = 101 feet.

3. Measuring height on sloping ground by using a baseline distance other than 100 feet.

It is often hard to measure heights from exactly 100 feet away, particularly if thick brush or downed logs hide your view of the tree’s base. And as explained earlier, you will generally want to measure height from more than 100 feet away for very tall trees to stay within the accurate range of an instrument’s scales.

For these trickier situations, you’ll need to measure height from a distance other than 100 feet, and then adjust the clinometer results accordingly. Here’s a height measurement example using a baseline distance other than 100 feet:



Measuring tree height on sloping ground by using a percent clinometer and a baseline distance other than 100 feet.

Here is what you’d do to measure this tree’s height:

a. Use the clinometer to measure a slope percent to eye height on the tree (30 percent in this example).
b. Get a slope correction factor from table 1 (1.04 for 30 percent).
c. Multiply the slope correction factor by your baseline distance: 60 feet × 1.04 = 62.4 feet.

This calculated value (62.4 feet) is referred to as a slope-corrected baseline distance because ***62.4 feet, on a 30% slope, is the same as 60 feet on flat ground*** (the flat-ground equivalent, 60 feet in this instance, is referred to as horizontal distance).

d. Back up to 62.4 feet before taking clinometer readings of the tree's top and base.
e. Take clinometer readings of the top and base, and add them together. In our example, the result is: 32 + 74 = 106.
f. Does this mean that the tree is 106 feet tall? No, it does not! A percent clinometer, which is what we've been using for these examples, is intended for a 100-foot baseline, so if you are not 100 feet from the tree (slope-corrected distance), then the clinometer readings must be adjusted for a different baseline distance. In our example, the slope-corrected baseline distance was only 60 feet, not 100.
g. Calculate a baseline adjustment factor by dividing your baseline distance by 100: 60 feet ÷ 100 = 0.6.
h. Multiply the sum of the clinometer readings (see step 5 above) by the adjustment factor to finally get a total height for your tree: 106 × 0.6 = 63.6 feet.

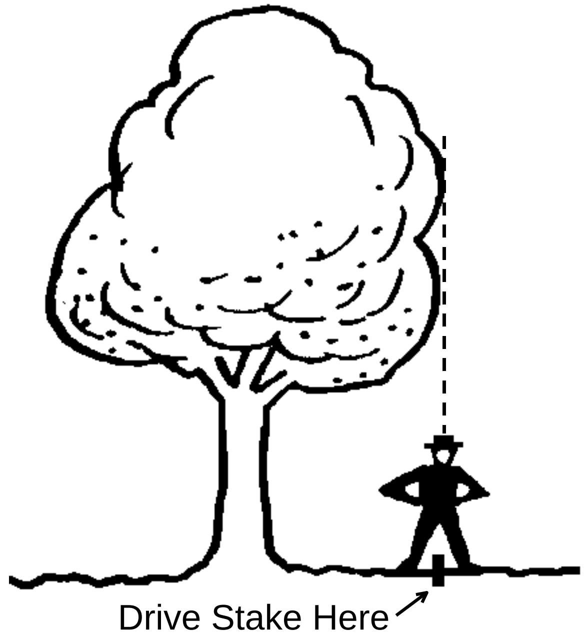
Table 1: Slope correction factors

Slope Percent	Correction Factor
0 – 9	1.00
10 – 17	1.01
18 – 22	1.02
23 – 26	1.03
27 – 30	1.04
31 – 33	1.05
34 – 36	1.06
37 – 39	1.07
40 – 42	1.08
43 – 44	1.09
45 – 47	1.10
48 – 49	1.11
50 – 51	1.12
52 – 53	1.13
54 – 55	1.14
56 – 57	1.15
58 – 59	1.16
60 – 61	1.17

CROWN SPREAD

Average crown spread is a measurement that we seldom collect as part of our normal job. This differs from diameter or height, both of which are commonly measured when completing stand examinations or timber cruises.

To determine a tree's average crown spread, you first find the widest extent of the tree's crown. This point is marked on the ground. If you bring some wooden stakes along, such as those used for road surveys or plantation survival checks, it will make this part of your measurement job easier.



Here's how it is done. Walk around beneath the tree and visually determine where the tree's branches extend farthest from the stem. Drive a stake in the ground at that point.

Next, follow an imaginary line that goes from the stake to the opposite side of the crown; the line must pass through the center of the tree's stem. Line yourself up with the outside of the crown on the opposite side from your first stake (having an assistant help you here is a good idea), and drive a stake at this point.

Then complete the same process to measure the crown width for a line established at a right angle (90°) from your first line. Walk along the 90°-line and find the point at which the crown is farthest to the stem. Drive a stake at this point; move to the opposite side of the crown as you did before, and drive a stake there too.

You have now marked the widest and narrowest dimensions of the tree's crown. Measure the distance between the stakes marking the widest part of the crown, in feet. Measure the distance between the stakes marking the 90° line. Calculate an average crown spread by adding the numbers together, and then dividing by two. Record the average crown spread value on the big-tree nomination form.

SCORING FORMULA

Each tree is evaluated by using a point system – one point for each inch of circumference, one point for each foot of height, and ¼ point for each foot of crown spread.

After the measurements have been collected, your tree's final score will be calculated using this formula developed by American Forests (administrator of the national Big Tree program):

Circumference (inches) + Height (feet) + ¼ of crown spread (feet) = Score (points)

If you are starting with a diameter (DBH) in inches, multiply it by π (pi; 3.14) to convert from diameter to circumference. For example, let's say you submit a western white pine with a 63.1" diameter (measured at 4½ feet above average ground level), a 198' height, and a 24' average crown spread (wide and 90° dimensions averaged together).

The DBH would first need to be converted to circumference by multiplying 63.1 by π (3.14), which yields 198.1 (round it to the nearest whole number when using the formula).

So, the final score for this example tree would then be calculated this way:

198" circumference + 198' height + 6' (¼ of 24' crown spread) = 402 points

TREE REFERENCES

This list provides useful tree identification references for the Pacific Northwest. To aid in locating or purchasing them, I have included their ISBN number, which is an international catalog number (each book is assigned its own unique ISBN number; for online ordering, the ISBN number can be entered in a Search box for quick access to the book's information).

Arno, S.F.; Hammerly, R.P. 1979. Northwest trees. Seattle, WA: The Mountaineers. 222 p. [This guidebook covers southern British Columbia, Washington, northern Oregon, northern Idaho, and northwestern Montana. ISBN: 0916890503]

Brayshaw, T.C. 1996. Trees and shrubs of British Columbia. Vancouver, BC: UBC Press. 374 p. [Although developed for British Columbia, this guide is actually useful for the entire Northwest. ISBN: 0774805641]

Elias, T.S. 2000. The complete trees of North America: field guide and natural history. New York: Van Nostrand Reinhold Company. 948 p.
[This book may be less useful than a regional guide due to its large size. ISBN: 0442238622]

Farrar, J.L. 1995. Trees of the northern United States and Canada. Ames, IA: Iowa State University Press. 502 p.
[My personal favorite; comprehensive descriptions, beautiful photographs and illustrations, and innovative keys. ISBN: 081382740X]

Harlow, W.M.; Harrar, E.S.; Hardin, J.W.; White, F.M. 1996. Textbook of dendrology. New York: McGraw-Hill, Inc. 534 p.
[Provides a complete description for most species, including distinguishing characteristics and range maps. ISBN: 0070265720]

Henigman, J.; Ebata, T.; Allen, E.; Westfall, J.; Pollard, A. 2001. Field guide to forest damage in British Columbia. Joint Pub. Number 17. Victoria, BC: British Columbia Ministry of Forests; Canadian Forest Service. 370 p.
[Includes excellent color photographs; covers a very wide range of forest insects and diseases. ISBN: 0772644160]

Hitchcock, C.L.; Cronquist, A. 1973. Flora of the Pacific Northwest. Seattle, WA: University of

Washington Press. 730 p.
[Primary botanical reference for the Pacific Northwest. Can be difficult to use for a non-botanist. ISBN: 0295952733]

Jensen, E.C. 2010. Trees to know in Oregon. Extension Circular 1450. Corvallis, OR: Oregon State University, Extension Service, Extension & Station Communications. 151 p. [Definitive tree guide for Oregon, including excellent color photographs and an attractive layout. ISBN: 1931979049. There is also a companion guide called *Shrubs to Know in Pacific Northwest Forests*; Extension Circular 1640.]

Johnson, C.G., Jr. 1998. Common plants of the inland Pacific Northwest. Portland, OR: USDA Forest Service, Pacific Northwest Region. 394 p.
[Available from Northwest Interpretative Association outlets. Also a good reference for identifying shrubs, grasses, and forbs. No ISBN number available.]

Kershaw, L.; MacKinnon, A.; Pojar, J. 1998. Plants of the Rocky Mountains. Edmonton, AB: Lone Pine Publishing. 384 p.
[This is also a good wildflower reference. ISBN: 1551050889]

Kuhns, M. 1998. Trees of Utah and the intermountain west: a guide to identification and use. Logan, UT: Utah State University Press. 341 p.
[Good line drawing illustrations; ISBN: 0874212448]

Little, E.L. 1980. The Audubon Society field guide to North American trees; western region. New York: Alfred A. Knopf, Inc. 639 p.
[Excellent color photographs for each species; ISBN: 0394507614]

McMinn, H.E.; Maino, E. 1981. An illustrated manual of Pacific coast trees. Berkeley, CA: University of California Press. 409 p.
[Comprehensive and with detailed descriptions, but illustrations are just line drawings. ISBN: 0520043642]

Nixon, E.S.; Cunningham, B.L. 2010. Gymnosperms of the United States and Canada. Nacogdoches, TX: Bruce Lyndon Cunningham Productions. 200 p.
[This guide includes conifers only, and its scope is wide enough that species descriptions are not specific to our area, but illustrations are detailed. ISBN: 9780934115032]

Parish, R. 1995. Tree book: learning to recognize trees of British Columbia. Victoria, BC: Canadian Forest Service. 183 p.
[An excellent reference. ISBN: 0772621594]

Parish, R.; Coupe, R.; Lloyd, D. 1996. Plants of southern interior British Columbia and the inland northwest. Vancouver, BC: Lone Pine Publishing. 463 p.
[Guide has excellent photos and illustrations. ISBN: 1551052199]

Peattie, D.C. 1980. A natural history of western trees. Lincoln, NB: University of Nebraska Press. 751 p.
[Provides natural history information and interesting facts about western trees. Some illustrations are included. ISBN: 0803287011]

Petrides, G.A.; Petrides, O. 1998. A field guide to western trees. New York: Houghton Mifflin Company. 428 p.
[Includes nice color photos and drawings. ISBN: 0395904544]

Petrides, G.A.; Petrides, O. 2000. Trees of the Rocky Mountains and intermountain West. Williamston, MI: Backpacker Field Guide Series. 111 p.
[This small guide includes black-and-white drawings for each species. ISBN: 0964667428]

Petrides, G.A.; Petrides, O.; Wehr, J. 1993. Peterson first guide to trees. New York: Houghton Mifflin Company. 128 p.
[This small guide includes nice color drawings for each species. Its coverage of western trees is limited. ISBN: 0395911834]

Stuckey, M.; Palmer, G. 1998. Western trees: a field guide. Helena, MT: Falcon Publishing, Inc. 143 p.
[Includes black-and-white line drawings for each species. ISBN: 1560446234]

Zim, H.S.; Martin, A.C. 1987. Trees: a guide to familiar American trees. New York: Golden Books Publishing Company, Inc. 160 p.
[This familiar, small-format guide is written simply enough for upper elementary and middle school children; it includes color drawings for 143 important species. ISBN: 0307240568]

APPENDIX: SILVICULTURE WHITE PAPERS

White papers are internal reports, and they are produced with a consistent formatting and numbering scheme – all papers dealing with Silviculture, for example, are placed in a silviculture series (Silv) and numbered sequentially. Generally, white papers receive only limited review and, in some instances pertaining to highly technical or narrowly focused topics, the papers may receive no technical peer review at all. For papers that receive no review, the viewpoints and perspectives expressed in the paper are those of the author only, and do not necessarily represent agency positions of the Umatilla National Forest or the USDA Forest Service.

Large or important papers, such as two papers discussing active management considerations for dry and moist forests (white papers Silv-4 and Silv-7, respectively), receive extensive review comparable to what would occur for a research station general technical report (but they don't receive blind peer review, a process often used for journal articles).

White papers are designed to address a variety of objectives:

(1) They guide how a methodology, model, or procedure is used by practitioners on the Umatilla National Forest (to ensure consistency from one unit, or project, to another).

(2) Papers are often prepared to address ongoing and recurring needs; some papers have existed for more than 20 years and still receive high use, indicating that the need (or issue) has long standing – an example is white paper #1 describing the Forest's big-tree program, which has operated continuously for 25 years.

(3) Papers are sometimes prepared to address emerging or controversial issues, such as management of moist forests, elk thermal cover, or aspen forest in the Blue Mountains. These papers help establish a foundation of relevant literature, concepts, and principles that continuously evolve as an issue matures, and hence they may experience many iterations through time. [But also note that some papers have not changed since their initial development, in which case they reflect historical concepts or procedures.]

(4) Papers synthesize science viewed as particularly relevant to geographical and management contexts for the Umatilla National Forest. This is considered to be the Forest's self-selected 'best available science' (BAS), realizing that non-agency commenters would generally have a different conception of what constitutes BAS – like beauty, BAS is in the eye of the beholder.

(5) The objective of some papers is to locate and summarize the science germane to a particular topic or issue, including obscure sources such as master's theses or Ph.D. dissertations. In other instances, a paper may be designed to wade through an overwhelming amount of published science (dry-forest management), and then synthesize sources viewed as being most relevant to a local context.

(6) White papers function as a citable literature source for methodologies, models, and procedures used during environmental analysis – by citing a white paper, specialist reports can include less verbiage describing analytical databases, techniques, and so forth, some of which change little (if at all) from one planning effort to another.

(7) White papers are often used to describe how a map, database, or other product was developed. In this situation, the white paper functions as a 'user's guide' for the new product. Examples include papers dealing with historical products: (a) historical fire extents for the Tucannon watershed (WP Silv-21); (b) an 1880s map developed from General Land Office survey notes (WP Silv-41); and (c) a

description of historical mapping sources (24 separate items) available from the Forest's history website (WP Silv-23).

The following papers are available from the Forest's website: Silviculture White Papers

Paper #	Title
1	Big tree program
2	Description of composite vegetation database
3	Range of variation recommendations for dry, moist, and cold forests
4	Active management of dry forests in the Blue Mountains: silvicultural considerations
5	Site productivity estimates for upland forest plant associations of the Blue and Ochoco Mountains
6	Fire regimes of the Blue Mountains
7	Active management of moist forests in the Blue Mountains: silvicultural considerations
8	Keys for identifying forest series and plant associations of the Blue and Ochoco Mountains
9	Is elk thermal cover ecologically sustainable?
10	A stage is a stage is a stage…or is it? Successional stages, structural stages, seral stages
11	Blue Mountains vegetation chronology
12	Calculated values of basal area and board-foot timber volume for existing (known) values of canopy cover
13	Created opening, minimum stocking, and reforestation standards from the Umatilla National Forest Land and Resource Management Plan
14	Description of EVG-PI database
15	Determining green-tree replacements for snags: a process paper
16	Douglas-fir tussock moth: a briefing paper
17	Fact sheet: Forest Service trust funds
18	Fire regime condition class queries
19	Forest health notes for an Interior Columbia Basin Ecosystem Management Project field trip on July 30, 1998 (handout)
20	Height-diameter equations for tree species of the Blue and Wallowa Mountains
21	Historical fires in the headwaters portion of the Tucannon River watershed
22	Range of variation recommendations for insect and disease susceptibility
23	Historical vegetation mapping
24	How to measure a big tree
25	Important insects and diseases of the Blue Mountains
26	Is this stand overstocked? An environmental education activity
27	Mechanized timber harvest: some ecosystem management considerations
28	Common plants of the south-central Blue Mountains (Malheur National Forest)
29	Potential natural vegetation of the Umatilla National Forest
30	Potential vegetation mapping chronology
31	Probability of tree mortality as related to fire-caused crown scorch
32	Review of the "Integrated scientific assessment for ecosystem management in the interior Columbia basin, and portions of the Klamath and Great basins" – forest vegetation
33	Silviculture facts
34	Silvicultural activities: description and terminology

Paper #	Title
35	Site potential tree height estimates for the Pomeroy and Walla Walla ranger districts
36	Tree density protocol for mid-scale assessments
37	Tree density thresholds as related to crown-fire susceptibility
38	Umatilla National Forest Land and Resource Management Plan: forestry direction
39	Updates of maximum stand density index and site index for the Blue Mountains variant of the Forest Vegetation Simulator
40	Competing vegetation analysis for the southern portion of the Tower Fire area
41	Using General Land Office survey notes to characterize historical vegetation conditions for the Umatilla National Forest
42	Life history traits for common conifer trees of the Blue Mountains
43	Timber volume reductions associated with green-tree snag replacements
44	Density management field exercise
45	Climate change and carbon sequestration: vegetation management considerations
46	The Knutson-Vandenberg (K-V) program
47	Active management of quaking aspen plant communities in the northern Blue Mountains: regeneration ecology and silvicultural considerations
48	The Tower Fire…then and now. Using camera points to monitor postfire recovery
49	How to prepare a silvicultural prescription for uneven-aged management
50	Stand density conditions for the Umatilla National Forest: a range of variation analysis
51	Restoration opportunities for upland forest environments of the Umatilla National Forest
52	New perspectives in riparian management: Why might we want to consider active management for certain portions of riparian habitat conservation areas?
53	Eastside Screens chronology
54	Using mathematics in forestry: an environmental education activity
55	Silviculture certification: tips, tools, and trip-ups
56	Vegetation polygon mapping and classification standards: Malheur, Umatilla, and Wallowa-Whitman national forests
57	The state of vegetation databases on the Malheur, Umatilla, and Wallowa-Whitman national forests
58	Seral status for tree species of the Blue and Ochoco Mountains

REVISION HISTORY

July 2005: The first version of this white paper was prepared sometime in the mid-1990s to help support implementation of the Umatilla NF's big-tree program (early versions were not saved, so the first version is shown as July 2005).

December 2016: Minor formatting and editing changes were made, including adding a white-paper header and assigning a white-paper number; an appendix was added describing the white paper system, including a list of available white papers. An Historical Context section was added.